

Phobos Sample Return

A joint ESA/ROSCOSMOS sample return mission

Return 100g of surface sample from the Mars moon Phobos

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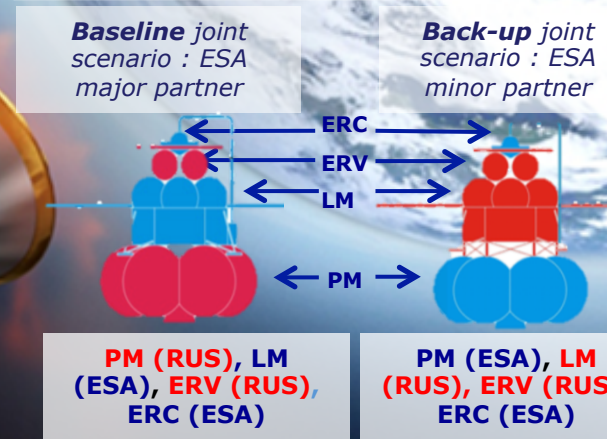
Background & Introduction

Phobos Sample Return (**PhSR**) is a Mars Robotic Exploration Preparation (MREP) programme candidate in cooperation with Roscosmos, currently under assessment by ESA (phase A with Airbus D&S and Thales Alenia Space). It builds on the **Phootprint** pre-phase A (concluded in 2014) and the **PhSR joint ESA/ROSCOSMOS CDF study** (held in 2014). Two cooperation scenarios and an ESA-standalone scenario are being investigated. PhSR main objective is to acquire and return a 100gr sample from the surface of Phobos after a scientific characterisation phase of the moon and of the landing site. PhSR offers an excellent opportunity to unlock the secrets of Phobos and its formation while preparing for Mars Sample Return (MSR) with a number of critical technologies that are targeted to be used for the European contribution to MSR, including sampling, sample transfer and sealing, Rendezvous in Mars orbit, Earth Return Capsule and the Sample Receiving Facility.

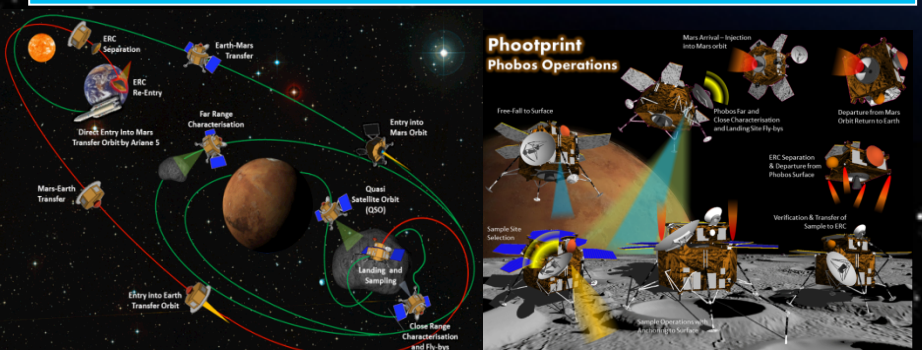
Mission Overview	
Launcher	Proton for the joint scenarios / Ariane 5 ECA or 6.4 for the ESA-standalone
Launch date	Baseline 2024, back-up 2026
Space Segment	Staged Spacecraft composed of 4 elements: Lander Module (LM), Earth Return Vehicle (ERV) and Earth Re-entry Capsule (ERC) and a Propulsion Module (PM)
Mission profile	Arrival at Mars in July 2025 / 1 month around Deimos (trailing orbit and Quasi-satellite orbit) / 4 months around Phobos (Quasi-Satellite Orbit and fly-bys) / Landing & surface operations of few days / Departure from Mars August 2026 / Earth arrival July 2027
Ground Segment	35m ESA ground station for science & ground operations and Russian deep space stations as required
Planetary Protection	Category V- Unrestricted Earth-Return (to be confirmed)

Strawman Payload (from Phootprint study)		
Wide Angle Camera (WAC)	2.15 kg	Distant, global and local characterisation.
Narrow Angle Camera (NAC)	10.57 kg	Distant, global and local characterisation.
Visible/Near Infrared Spect. (VisNIR)	6.24 kg	Distant, global and local characterisation.
mid-Infrared Spect. (mid-IR)	5.32 kg	Distant, global and local characterisation.
Sample area Context Imager (SaCI)	1 kg	Sample context characterisation.
Sampling point Close-Up Imager (CLUPI)	0.28 kg	Sample context characterisation.
Control Support Unit (WAC and NAC)	3 kg	N/A
Imaging Main Electronics (SaCI and CLUPI)	1.5 kg	N/A
Radio Science Experiment	N/A	Part of the TT&C system
	30.0 kg	Σ mass (w/o margins)
	140 Gbits	Total Mission Data Volume

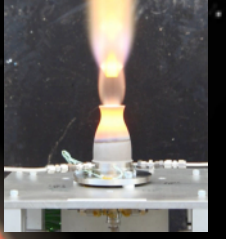
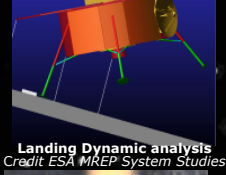
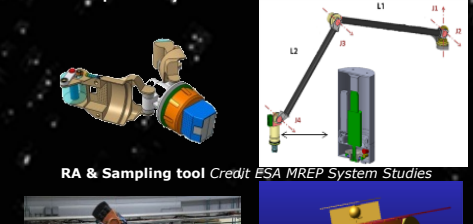
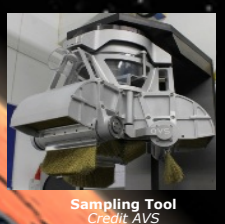
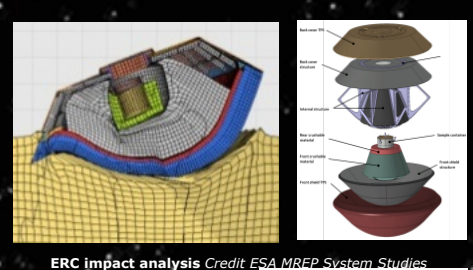
Joint ESA-ROSCOSMOS scenarios



Mission Operations Concept (from Phootprint study)



Main Technologies	
Spacecraft main Engine	1100N High Trust Apogee Engine (HTAE)
GNC for descent and landing (incl. FDIR)	Direct descent from QSO or hovering above landing site
Landing gear (legged system)	Perform a safe and stable landing
Sample Acquisition, Transfer & Containment System	Collect sample material from Phobos surface, transfer it to the ERC and seal it until return
Earth Re-entry capsule (ERC)	Perform a ~ 12 km/s re-entry and deliver the sample container safely on ground with no parachute



MREP Mars Robotic Exploration Preparation Programme

Heritage : Phobos Sample Return joint ESA-ROSCOSMOS CDF (2014)		
CDF report available on : http://sci.esa.int/future-missions-office/55323-cdf-study-report-phobos-sample-return/		
baseline	Mass	Back-up
1694.1 kg	Composite Dry (incl. all margins)	1750.4 kg
2005 kg	Propellant	2964 kg
100	Proton Breeze M / PM adapter	115
3799.1 kg	2024 - Wet	4829.4 kg

